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SCIENCE

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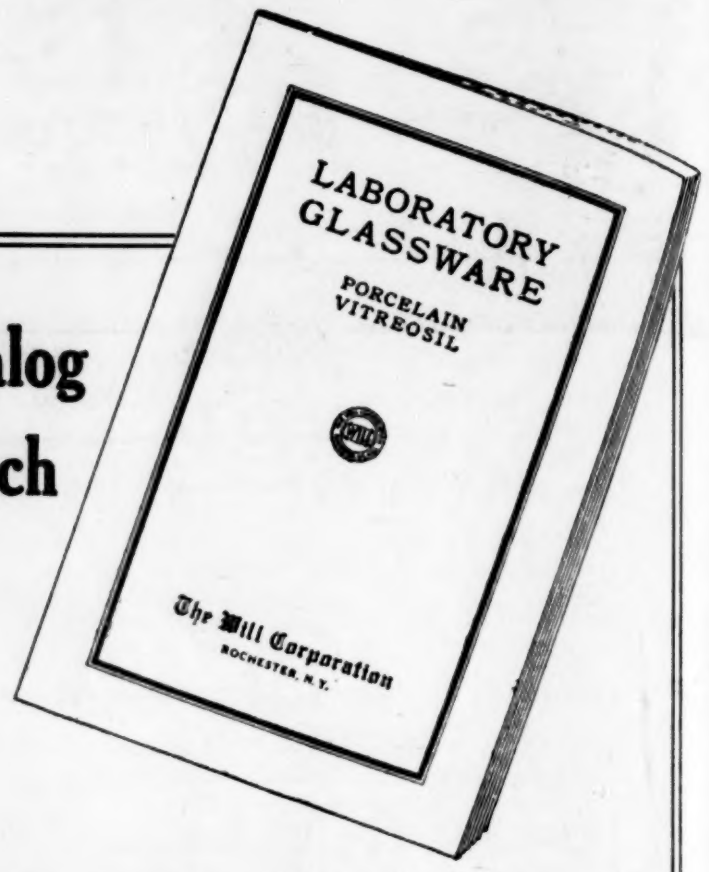

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SCIENCE

FRIDAY, MAY 2, 1919

CONTENTS

Cooperation between Zoological Laboratories and the Government Bureaus: E. W. NELSON. 409

The History of Poison Gases: MAJOR CLARENCE J. WEST 413

Duty Free Supplies: DR. THOMAS B. FREAS AND DR. W. L. ESTABROOKE 417

Scientific Events:—
The Use of Reinforced Concrete in Shipbuilding; Education and Science in the British Civil Service Estimates; Appointments at Harvard University 419

Scientific Notes and News 421

University and Educational News 422

Discussion and Correspondence:—
Erroneous Generic Determinations of Bees: DR. CHARLES ROBERTSON. *Geomorphology:* C. A. COTTON. *"A Wave of Life:"* G. B. CLAYCOMB 422

Quotations:—
The Physiology of a Working Day 424

Scientific Books:—
Washburn on Injurious Insects and Useful Birds: W. E. BRITTON 425

Anthropological Research: DRS. FRANZ BOAS, ALEŠ HRDLIČKA, ALFRED M. TOZZER 426

Special Articles:—
Egg-weight as a Criterion of Numerical Production in the Domestic Fowl: DR. PHILIP HADLEY 427

Societies and Academies:—
The National Academy of Sciences 429

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COOPERATION BETWEEN ZOOLOGICAL LABORATORIES AND THE GOVERNMENT BUREAUS

THE establishment of the Council of National Research and the utilization of a host of other scientific workers from universities and colleges in all sections of the country as parts of the war machinery of the government has for a considerable period and on a large scale brought the college scientists in close contact with the scientists of the governmental bureaus in Washington. This has, I believe, brought about a mutual feeling of friendship and cordial understanding far beyond anything hitherto existing.

Now that the extraordinarily varied scientific work being regularly conducted in Washington under governmental auspices has become more widely known to college workers, the way is open to make this information useful. For instance, would it not be practicable for the head of each college biological or zoological laboratory to make a point year by year to secure first-hand information as to the many lines of governmental work in progress in his branch of science, both as to research problems and as to the application of scientific knowledge to economic work? Probably no field of research offers the student a greater number of subjects of general value to the community.

Possibly the college zoological laboratories might obtain funds, perhaps as fellowships or in other form, with which the more promising students could be given opportunity to visit government laboratories in Washington and elsewhere and become acquainted with government workers in the lines in which they are interested. In this way they could get definite information as to methods of research, the practical handling of various problems and the technique of the leading government

workers, which could not fail to be most helpful in their subsequent studies.

Men of ability could often find opportunity to take up cooperative work in connection with government investigations and eventually many of them would unquestionably join the army of scientific men in the government service, which is helping build up modern agriculture and other forms of food production and conservation, the public health and other beneficial activities.

The extent and variety of the zoological problems being handled by the government bureaus are well illustrated in the activities of the Bureau of Fisheries of the Department of Commerce and in the Bureaus of Animal Industry, Entomology and Biological Survey of the Department of Agriculture, represented here to-day.

The close relationship often existing between technical scientific investigations and the practical application of the knowledge thus obtained is well illustrated by the development of the Bureau of Biological Survey. In its early history the small organization which has since become the present bureau, while taking up certain problems concerning the economic relations of birds, devoted much the larger part of its attention to essentially technical field and laboratory investigations of our native birds and mammals. As the investigations advanced new vistas were opened and numerous practical problems demanded attention. As a natural evolution the technical work became the foundation of the practical work directly for the public benefit.

The facts developed from exact study of the food of birds through microscopic examination of their stomach contents, with field observations on their numbers and distribution, so conclusively demonstrated the value of birds as insect destroyers that public opinion has caused the passage of state laws for their protection throughout the country. The latest result has been a treaty between the United States and Great Britain for the protection of migratory birds in this country and Canada.

The investigators of the food habits of birds must have, in addition to a knowledge of birds, a good working knowledge of insects and of plants. Studies of the food habits of birds are constantly in progress and there is always room for additional investigators in this field.

As the result of the field investigations of the distribution and habits of birds and mammals large series of specimens have been collected and early in the work the fact developed that there existed a surprising lack of technical knowledge concerning our bird and mammal life. In consequence, a number of investigators have been engaged for years in the study of these and other recent collections, and numerous monographs of groups of mammals and shorter papers on birds have been published. These studies have resulted in the discovery of new genera and hundreds of previously unknown species, especially of mammals. The field is still a promising one, particularly as concerns the anatomy, osteology and embryology, and the life histories of most of the species.

The Biological Survey is charged with the administration of the federal laws for the protection of birds, which entails investigations, both technical and non-technical, in order to supply information covering a wide range. Among other tasks it is our duty to determine which species are beneficial and which harmful, and to discover methods for the control of the harmful species.

In addition it is necessary to have definite information concerning foreign birds and mammals, since the law requires that control shall be exercised over the importation of birds and mammals of injurious habits in order to prevent their becoming established here. For example, the colonization of the mongoose in this country would be a calamity of far-reaching effect. At the same time the importation of certain harmless and useful species is encouraged.

With the increased occupation and great extension of farming and stockgrowing throughout the country it has developed that certain native mammals which exist in enormous numbers have become excessively destructive to the crop and meat output. Predatory ani-

mals, such as wolves, coyotes and others, have been killing more than $20,000,000 worth of live stock yearly on the western ranges, while swarming millions of rodents, such as prairie-dogs, ground squirrels, jack rabbits, field mice and others, were destroying farm crops, orchards and forage to the approximate value of $300,000,000 yearly. Through investigations of representatives of the Biological Survey, effective methods have been developed for the destruction of these pests on a large scale. These pests occupy such an enormous area, however, that the cost of handling the problem is a large one. Improvements in this work are still possible and investigations are being continued to devise still more economical and effective methods.

Recently other investigations have been begun to determine with scientific accuracy, through fenced plots of land in the west, the definite amount of injury done to forage production by the principal different kinds of rodents. There is much room for cooperation here and the results will be of the utmost practical value.

The Forest Service finds it impossible in many places to accomplish successful reforesting by seeding until the native mice, and sometimes chipmunks and other rodents in the vicinity, are destroyed. This leads directly to the fact, which has become recognized only recently among a few investigators, that mice and other small rodents, common nearly everywhere and which swarm in surprising abundance over vast areas exercise a great and at times perhaps controlling influence on the character of the vegetation prevailing, including forest production. Dr. MacDougal, of the Carnegie Desert Laboratory, at Tucson, Ariz., informs me that he finds the small desert rodents have a decided effect on the character of the desert vegetation through their destruction of seeds and of the sprouting plants. The exact facts in regard to this relationship between rodents and the native vegetation are not definitely known in the case of a single one among the hundreds of species of these small animals.

The study of our bird and mammal life and its relation to its environment, its distribution and other factors in the life history of the species are in part the object of the biological surveys of the states which the Biological Survey is conducting as rapidly as its means will permit. These investigations include both the field study of the birds and mammals and the technical investigations relating to their taxonomic characters in the laboratory. To enter into investigations such as those mentioned above requires a technical knowledge of the species of birds and mammals.

The house rat causes losses approximating $200,000,000 yearly in the United States. One of the greatest needs in controlling these pests is an effective poison which they will take freely. The investigator who discovers this will do a great service not only to this country but to the world. Little exact knowledge is available as to the relation of rats to the spread of diseases of man other than bubonic plague.

It is also desirable and important to learn whether other native rodents than the California ground squirrel are susceptible to the plague and can transmit it. The ground squirrel named is known to be a plague carrier. In important practical questions, such as that of determining the disease-carrying rodents, a technical knowledge of the various species and their distribution becomes of prime importance.

Many of the government bureaus, including the Biological Survey in the Department of Agriculture, are now cooperating with agricultural colleges and certain activities in universities. Yet the great majority of people out of Washington do not generally appreciate the real extent and variety of investigational activity in the capital, not even men engaged in related lines of work. The spirit of cooperation, however, is growing. An instance of this is the awakening interest of state institutions in the investigation of the relation of rodents to the production of forage plants, crops and other vegetation. A representative of the Agricultural College of Arizona is actively cooperating with the Biological Survey in a project of that character begun last

year in southern Arizona. The Agricultural College of the University of California has worked out a plan for cooperation with this bureau in the study of the relations of rodents to forage production in that state. The Museum of Vertebrate Zoology of the University of California is continually cooperating with the Biological Survey in its technical research relating to birds and mammals. Other universities have been cooperating along certain lines, as in the case of the Universities of Michigan, Wisconsin and Stanford with the Bureau of Fisheries. In some institutions of learning work is being conducted along lines parallel to that of the Bureau of Biological Survey, but without any definite cooperation and in some cases apparently without any definite effort to keep informed as to current work being done in Washington.

The biological surveys of the states covering field studies of the species of birds and mammals and the most characteristic vegetation and their distribution in relation to temperature or life zones, which this bureau has been conducting for many years, have in some instances, as in the case of Oregon and Washington, had local cooperation from state institutions. The bureau will be glad to see much more of this active cooperation developed in the future. Then, whenever a state survey is being conducted, students of the local colleges may have an opportunity for doing field work in the study of birds, mammals and the distribution of plants, thus gaining an insight into the relationships which exist in nature and obtaining a practical knowledge of field methods which have resulted from years of experience. The Biological Survey welcomes cooperation and will be glad to make itself helpful to students and laboratory workers who desire information or suggestions which may be useful in developing their studies.

In the practical handling of economic zoological problems it is interesting to note the close dependence of one specialist on another. The Biological Survey is continually forced to seek aid of the specialists in the Bureau of Entomology, in the Bureau of Animal Husbandry, in the Bureau of Plant Industry, and even in the Bureau of Chemistry. This being the case, it is evident that the college student of narrow viewpoint will be at a disadvantage when getting into professional scientific work.

The foregoing facts touching the work of the Biological Survey are illustrative of the many opportunities for useful research open to the student of birds and mammals. These opportunities form only an exceedingly small fraction of the vast field covered by economic zoology and the necessary attendant technical studies.

In its relations to the public welfare economic zoology is of the most vital and far-reaching importance. Animal life, from its lowliest organisms, among which lurk some of our deadliest foes as well as beneficent friends, to the highest vertebrates, touches and affects our lives and welfare in innumerable ways. It must be studied in all its phases as never before to guard against previously unsuspected or little-known diseases of man and domestic animals, as well as to develop the wealth and ever-increasing variety of products from which we obtain food, medicines, clothing, dyes, ornaments and an endless number of other useful articles. No man can now be considered well informed who has not a general knowledge of economic zoology in its more direct relationships to human life. The scientific investigator finds in the subject the charm of endless variety and of service to mankind.

E. W. Nelson

THE HISTORY OF POISON GASES

The introduction of poison gases by the Germans at Ypres in April, 1915, marked a new era in modern warfare. The popular opinion is that this form of warfare was original with the Germans. Such, however, is not the case. Quoting from an article in the *Candid Quarterly Review*, (4–561), "All they can claim is the inhuman adoption of devices invented in England, and by England rejected as too horrible to be entertained even for use against an enemy." But the use of

poison gases is even of an earlier origin than this article claims.

The first recorded effort to overcome an enemy by the generation of poisonous and suffocating gases seems to have been in the wars of the Athenians and Spartans (431–404 B.C.) when, besieging the cities of Platea and Belium, the Spartans saturated wood with pitch and sulphur and burned it under the walls of these cities in the hope of choking the defenders and rendering the assault less difficult. Similar uses of poisonous gases are recorded during the Middle Ages. In effect they were like our modern stink balls, but were projected by squirts or in bottles after the manner of a hand grenade. The legend is told of Prester John (about the eleventh century), that he stuffed copper figures with explosives and combustible materials which, emitted from the mouths and nostrils of the effigies, played great havoc.

The idea referred to by the writer in the *Candid* is from the pen of the English Lord Dundonald, which appeared in the publication entitled "The Panmure Papers." This is an extremely dull record of an extremely dull person, only rendered interesting by the one portion, concerned with the use of poison gases, which, it is said, "should never have been published at all."

The great Admiral Lord Dundonald—perhaps the ablest sea captain ever known, not even excluding Lord Nelson—was also a man of wide observation, and no mean chemist. He had been struck in 1811 by the deadly character of the fumes of sulphur in Sicily; and, when the Crimean War was being waged, he communicated to the English government, then presided over by Lord Palmerston, a plan for the reduction of Sebastopol by sulphur fumes. The plan was imparted to Lord Panmure and Lord Palmerston, and the way in which it was received is so illustrative of the trickery and treachery of the politician that it is worth while to quote Lord Palmerston's private communication upon it to Lord Panmure:

LORD PALMERSTON TO LORD PANMURE

"HOUSE OF COMMONS, 7th August, 1855

"I agree with you that if Dundonald will go out himself to superintend and direct the execution of his scheme, we ought to accept his offer and try his plan. If it succeeds, it will, as you say, save a great number of English and French lives; if it fails *in his hands,* we shall be exempt from blame, and if we come in for a small share of the ridicule, we can bear it, and the greater part will fall on him. You had best, therefore, make arrangement with him without delay, and with as much secrecy as the nature of things will admit of."

Inasmuch as Lord Dundonald's plans have already been deliberately published by the two persons above named, there can be no harm in now republishing them. They will be found in the first volume of "The Panmure Papers" (pp. 340–342) and are as follows:

"(ENCLOSURE)

"BRIEF PRELIMINARY OBSERVATIONS

"It was observed when viewing the Sulphur Kilns, in July, 1811, that the fumes which escaped in the rude process of extracting the material, though first elevated by heat, soon fell to the ground, destroying all vegetation, and endangering animal life to a great distance, as it was asserted that an ordinance existed prohibiting persons from sleeping within the distance of three miles during the melting season.

"An application of these facts was immediately made to Military and Naval purposes, and after mature consideration, a Memorial was presented on the subject to His Royal Highness the Prince Regent on the 12th of April, 1812, who was graciously pleased to lay it before a Commission, consisting of Lord Keith, Lord Exmouth and General and Colonel Congreve (afterwards Sir William), by whom a favorable report having been given, His Royal Highness was pleased to order that secrecy should be maintained by all parties.

"(Signed) DUNDONALD

"7th August, 1855"

"MEMORANDUM

"Materials required for the expulsion of the Russians from Sebastopol: Experimental trials have shown that about five parts of coke effectually vaporize one part of sulphur. Mixtures for land service, where weight is of importance, may, however, probably be suggested by Professor Faraday, as to operations on shore I have paid little attention. Four or five hundred tons of sulphur and two thousand tons of coke would be sufficient.

"Besides these materials, it would be necessary to have, say, as much bituminous coal, and a couple

of thousand barrels of gas or other tar, for the purpose of masking fortifications to be attacked, or others that flank the assailing positions.

"A quantity of dry firewood, chips, shavings, straw, hay or other such combustible materials, would also be requisite quickly to kindle the fires, which ought to be kept in readiness for the first favourable and steady breeze.

"Dundonald

"7th August, 1855."

"*Note.*—The objects to be accomplished being specially stated the responsibility of their accomplishment ought to rest on those who direct their execution.

"Suppose that the Malakoff and Redan are the objects to be assailed it might be judicious merely to obscure the Redan (by the smoke of coal and tar kindled in 'The Quarries'), so that it could not annoy the Mamelon, where the sulphur fire would be placed to expel the garrison from the Malakoff, which ought to have all the cannon that can be turned towards its ramparts employed in overthrowing its undefended ramparts.

"There is no doubt but that the fumes will envelop all the defenses from the Malakoff to the Barracks, and even to the line of battleship, the Twelve Apostles, at anchor in the harbour.

"The two outer batteries, on each side of the Port, ought to be smoked, sulphured, and blown down by explosion vessels, and their destruction completed by a few ships of war anchored under cover of the smoke."

That was Lord Dundonald's plan in 1855, improperly published in 1908, and by the Germans, who thus learnt it, ruthlessly put into practise in 1915.

Lord Dundonald's memoranda, together with further elucidatory notes, were submitted by the English government of that day to a committee and subsequently to another committee in which Lord Playfair took leading part. These committees, with Lord Dundonald's plans fully and in detail before them, both reported that the plans were perfectly feasible; that the effects expected from them would undoubtedly be produced; but that those effects were so horrible that no honorable combatant could use the means required to produce them. The committee therefore recommended that the scheme should not be adopted; that Lord Dundonald's account of it should be destroyed. How the records were obtained and preserved by those who so improperly published them in 1908 we do not know. Presumably they were found among Lord Panmure's papers. Admiral Lord Dundonald himself was certainly no party to their publication.

Thus it will be seen that the plan which England had rejected as being too horrible for use in warfare has been, through the deplorable conduct of those who somehow obtained and published it, stolen from us by the Germans, and first used against us. That having been done, we cannot choose but retaliate in kind; for when such methods of warfare are used against us we must, for our own protection and that of our soldiers, ourselves use means similar and as efficacious. Such means lie ready to our hand in Admiral Lord Dundonald's plans; and it is to be presumed that they are now worked out and perhaps improved upon by the modern chemists so as to enable us effectually to give back to the Germans as good a gas as they send us.

One of the early, if not the earliest suggestion as to the use of poison gas in shell is found in an article of "Greek Fire," by B. W. Richardson.[1]

He says:

I feel it a duty to state openly and boldly, that if science were to be allowed her full swing, if society would really allow that "all is fair in war," war might be banished at once from the earth as a game which neither subject nor king dare play at. Globes that could distribute liquid fire could distribute also lethal agents, within the breath of which no man, however puissant, could stand and live. From the summit of Primrose Hill, a few hundred engineers, properly prepared, could render Regent's Park, in an incredibly short space of time, utterly uninhabitable; or could make an army of men, that should even fill that space, fall with their arms in their hands, prostrate and helpless as the host of Sennacherib.

The question is, shall these things be? I do not see that humanity should revolt, for would it not be better to destroy a host in Regent's Park by making the men fall as in a mystical sleep, than to let down on them another host to break their bones, tear their limbs asunder and gouge out their entrails with three-cornered pikes; leaving a vast majority undead, and writhing for hours in torments of the damned? I conceive, for one, that science would be blessed in spreading her wings on the blast, and breathing into the face of a desperate horde of men prolonged sleep—for it need not necessarily be a death—which they could not

[1] *Popular Science Review*, 3, 176, 1864.

grapple with, and which would yield them up with their implements of murder to an enemy that in the immensity of its power could afford to be merciful as Heaven.

The question is, shall these things be? I think they must be. By what compact can they be stopped? It were improbable that any congress of nations could agree on any code regulating means of destruction: but if it did, it were useless; for science becomes more powerful as she concentrates her forces in the hands of units, so that a nation could only act, by the absolute and individual assent of each of her representatives. Assume, then, that France shall lay war to England, and by superior force of men should place immense hosts, well armed, on English soil. Is it probable that the units would rest in peace and allow sheer brute force to win its way to empire? Or put English troops on French soil, and reverse the question?

To conclude. War has, at this moment, reached, in its details, such an extravagance of horror and cruelty, that it can not be made worse by any art, and can only be made more merciful by being rendered more terribly energetic. Who that had to die from a blow would not rather place his head under Nasmyth's hammer, than submit it to a drummer-boy armed with a ferrule?

The *Army and Navy Register* of May 29, 1915, reports that

among the recommendations forwarded to the Board of Ordnance and Fortifications there may be found many suggestions in favor of the asphyxiation process, mostly by the employment of gases contained in bombs to be thrown within the lines of the foe, with varying effects from peaceful slumber to instant death. One ingenious person suggested a bomb laden to its full capacity with snuff, which should be so evenly and thoroughly distributed that the enemy would be convulsed with sneezing, and in this period of paroxysm it would be possible to creep up on him and capture him in the throes of the convulsion.

That the use of poison gases was not new in the minds of military men follows logically from the fact that at the Hague Conference in 1899, the governments represented—and all the warring powers of the present great conflict were represented—pledged themselves not to use any projectiles whose only object was to give out suffocating or poisonous gases. At the Congress of 1907, article 23 of the rules adopted for war on land states:

It is expressly forbidden (*a*), to employ poisons or poisonous weapons.

Before the war suffocating cartridges were shot from the cartridge-throwing rifle of 26 mm. These cartridges were charged with ethyl bromoacetate, a slightly suffocating and non-toxic lachrymator. They were intended for attack on the flanking works of permanent fortifications, flanking casements or caponiers, into which they tried to make these cartridges penetrate by the narrow slits of the loopholes. The men who were serving the machine guns or the cannon of the flanking works would have been bothered by the vapor from the ethyl bromoacetate, and the assailant would have profited by their disturbance to get past the obstacle presented by the fortification. The employment of these devices, not entailing death, did not contravene the Hague conventions.

The only memorable operations in the course of which these devices were used before the war was the attack on the Bonnet gang at Choisy-le-roi.

In the war of the trenches there has been an abuse in the employment of these suffocating cartridges; an abuse because the small quantity of liquid that they contain, about 19 cubic centimeters, can produce no effect on a terrain without cover.

In connection with the suggested use of sulphur dioxide by Lord Dundonald and the proposed use of poisonous gases in shell, the following description of a charcoal respirator by Dr. J. Stanhouse,[2] communicated by Dr. George Wilson is of interest.

Dr. Wilson commenced by stating, that having read with much interest the account of Dr. Stenhouse's researches on the deodorizing and disinfecting properties of charcoal, and the application of these to the construction of a new and important kind of respirator, he had requested the accomplished chemist to send one of his instruments for exhibition to the society, which he had kindly done. Two of the instruments were now on the table, differing, however, so slightly in construction, that it would be sufficient to explain

[2] *Trans. Royal Scottish Soc. Arts*, 4, Appendix O, 198, 1854.

the arrangement of one of them. Externally, it had the appearance of a small fencing-mask of wire gauze, covering the face from the chin upwards to the bridge of the nose, but leaving the eyes and forehead free. It consisted, essentially, of two plates of wire gauze, separated from each other by a space of about one fourth or one eighth of an inch, so as to form a small cage filled with small fragments of charcoal. The frame of the cage was of copper, but the edges were made of soft lead, and were lined with velvet, so as to admit of their being made to fit the cheeks tightly and inclose the mouth and nostrils. By this arrangement, no air could enter the lungs without passing through the wire gauze and traversing the charcoal. An aperture is provided with a screw or sliding valve for the removal and replenishment of the contents of the cage, which consist of the siftings or riddlings of the lighter kinds of wood charcoal. The apparatus is attached to the face by an elastic band passing over the crown of the head and strings tying behind, as in the case of the ordinary respirator. The important agent in this instrument is the charcoal, which has so remarkable a power of absorbing and destroying irritating and otherwise irrespirable and poisonous gases or vapors that, armed with the respirator, spirits of hartshorn, sulphuretted hydrogen, hydrosulphuret of ammonia and chlorine may be breathed through it with impunity, though but slightly diluted with air. This result, first obtained by Dr. Stenhouse, has been verified by those who have repeated the trial, among others by Dr. Wilson, who has tried the vapors named above on himself and four of his pupils, who have breathed them with impunity. The explanation of this remarkable property of charcoal is two-fold. It has long been known to possess the power of condensing into its pores gases and vapors, so that if freshly prepared and exposed to these, it absorbs and retains them. But it has scarcely been suspected till recently, when Dr. Stenhouse pointed out the fact, that if charcoal be allowed to absorb simultaneously such gases as sulphuretted hydrogen and air, the oxygen of this absorbed and condensed air rapidly oxidizes and destroys the accompanying gas. So marked is this action, that if dead animals be imbedded in a layer of charcoal a few inches deep, instead of being prevented from decaying as it has hitherto been supposed that they would be by the supposed antiseptic powers of the charcoal, they are found by Dr. Stenhouse to decay much faster, whilst at the same time, no offensive effluvia are evolved. The deodorizing powers of charcoal are thus established in a way they never have been before; but at the same time it is shown that the addition of charcoal to sewage refuse lessens its agricultural value contemporaneously with the lessening of odor. From these observations, which have been fully verified, it appears that by strewing charcoal coarsely powdered to the extent of a few inches, over church-yards, or by placing it inside the coffins of the dead, the escape of noisome and poisonous exhalations may be totally prevented. The charcoal respirator embodies this important discovery. It is certain that many of the miasma, malaria and infectious matters which propagate disease in the human subjects, enter the body by the lungs, and impregnating the blood there, are carried with it throughout the entire body, which they thus poison. These miasma are either gases and vapors or bodies which, like fine light dust, are readily carried through the air; moreover, they are readily destroyed by oxidizing agents, which convert them into harmless, or at least non-poisonous substances, such as water, carbonic acid and nitrogen. There is every reason, therefore, for believing that charcoal will oxidize and destroy such miasma as effectually as it does sulphuretted hydrogen or hydrosulphuret of ammonia, and thus prevent their reaching and poisoning the blood. The intention accordingly is that those who are exposed to noxious vapors, or compelled to breathe infected atmospheres, shall wear the charcoal respirator, with a view to arrest and destroy the volatile poisons contained in these. Some of the non-obvious applications of the respirator were then referred to:

1. Certain of the large chemical manufacturers in London are now supplying their workmen with the charcoal respirators as a protection against the more irritating vapors to which they are exposed.

2. Many deaths have occurred among those employed to explore the large drains and sewers of London from exposure to sulphuretted hydrogen, etc. It may be asserted with confidence that fatal results from exposure to the drainage gases will cease as soon as the respirator is brought into use.

3. In districts such as the Campagna of Rome, where malaria prevails and to travel during night or to sleep in which is certainly followed by an attack of dangerous and often fatal ague, the wearing of the respirator even for a few hours may be expected to render the marsh poison harmless.

4. Those, who as clergymen, physicians or legal advisers, have to attend the sick-beds of sufferers from infectious disorders, may, on occasion, avail themselves of the protection afforded by Dr. Stenhouse's instrument during their intercourse with the sick.

5. The longing for a short and decisive war has led to the invention of "a suffocating bomb-shell," which on bursting, spreads far and wide an irrespirable or poisonous vapor; one of the liquids proposed for the shell is the strongest ammonia, and against this it is believed that the charcoal respirator may defend our soldiers. As likely to serve this end, it is at present before the Board of Ordnance.

Dr. Wilson stated, in conclusion, that Dr. Stenhouse had no interest but a scientific one in the success of the respirators. He had declined to patent them, and desired only to apply his remarkable discoveries to the abatement of disease and death. Charcoal had long been used in filters to render poisonous water wholesome; it was now to be employed to filter poisonous air.

CLARENCE J. WEST
CHEMICAL WARFARE SERVICE

DUTY FREE SUPPLIES

THE interest in duty-free material has changed to some extent since 1914 because of the impossibility since that time of importing materials from the Central Powers, the former source of supply. During the war some American firms have turned elsewhere, because our European Allies were not in a position to meet the demand.

When the duty-free law was passed, provision was made for the importation without tariff of materials for educational institutions and those engaged in scientific research. The purpose of this law, of course, was to give these institutions the advantage of anything that was made in foreign countries and thus American scientists and the country as a whole were enabled to receive the benefit of foreign endeavor as far as possible. This was a means of promoting knowledge and in the early days of scientific production was certainly of great benefit to this country, but it also had ill effects as by-products. Scientific materials were used in large quantities and though there was demand enough, it was difficult for a business to succeed in this country where labor is paid at a higher schedule than abroad. Consequently, many lines of supplies which were used in considerable quantities were almost exclusively imported from foreign countries. Of course, it is true that these supplies, from a financial standpoint, were of very little importance as far as the country at large is concerned, because the values concerned amount to only a few million dollars annually.

But it must be recognized that we learn to make things by actual experience, and if one produces scientific apparatus and produces it in an efficient and satisfactory manner, he is able consequently to produce a related thing for which there might be a critical need. For instance: when the war broke out and the importations from the Central Powers ceased, this country found itself almost entirely without optical glass. The optical glass used in scientific institutions had been imported and everything went along quite normally in peace times but with the outbreak of the war optical glass became a vital necessity, for one might say there is no instrument of defense which is not connected in some way with optical glass, ranging all the way from telescopes and field-glasses to eyeglasses. The country that can not produce such things satisfactorily and cheaply in an emergency is certainly greatly handicapped in providing defense. We all know of the consternation caused in this country in April, 1917, as the seriousness of the situation dawned upon the government and the public, when it was discovered that no optical glass, broadly speaking, was available for war work, the supply of foreign glass having been exhausted. Perhaps in a minor way this same state of affairs occurred in almost every other industry of scientific nature in this country. One need only consider the difficulty in securing such instruments as polariscopes and microscopes to realize the scarcity that is bound to exist where any one country is dependent upon another for absolutely necessary supplies.

Therefore it is certainly true that the na-

tional welfare requires that the manufacturer of scientific apparatus in this country should be sufficiently protected so as to be enabled to compete with foreign production. But, on the other hand, it is evident that if we make the duty on such supplies so rigid as to exclude foreign articles entirely, a decided handicap on knowledge must result, for it is well understood by those who have been in touch with scientific production that certain things, such as fine instruments and rare chemicals, can only be profitably made by one concern, perhaps, in the whole world. It does not pay any one else to compete with such a manufacturer as the sales are too small. If, for instance, there is need of some rare organic chemical that is only made by one man in the world and, while of very great scientific value, is not sufficiently used to warrant any two concerns to study the details of manufacture, it is obviously unwise to handicap any scientist in any country from obtaining this article. Many of the chemicals in Kahlbaum's list, so familiar to all in pre-war days, come in this category, and it can not be disputed that a prohibitive duty on such items will restrict research work to a considerable extent and serve no good purpose, because the amount of revenue received by the government is too small. In addition, the encouragement given to manufacturers to produce rare chemicals is almost nil and no American firm could be induced to undertake the task. Perhaps in the past the duty-free privilege to institutions was abused, not directly by the institutions, but because of the wording of the original law, for some articles which had acquired a commercial rather than a scientific standing could be imported duty-free by all institutions regardless of the fact whether the article was also produced in this country or not. The patriotic element played no part in the decision, even though the home-made article cost but little more than the imported one.

One great drawback to the importation of scientific apparatus has always been the great amount of time which elapses between placing the order and its delivery. In order to overcome this drawback many people, and this ingeniously, have sought to induce the importer to deliver the goods from the shelves and replace the article when the import shipment arrives. However, this was a distinct evasion of the law and it has been reported that certain firms have been threatened with fines for committing this evasion of the government regulations. In some cases these firms did this unknowingly for the accommodation of the institution. Again, in many cases the interest in the research had almost vanished before the article was delivered. Therefore, to meet the demand, firms that imported materials were compelled to carry immense stocks of imported articles in order that they might have on hand the kind of apparatus or the chemical required. This necessitated an enormous increase in the cost of apparatus to institutions. Furthermore, any improvements to apparatus which might occur to the scientist after having placed the order were impossible of execution, owing to the distance between the manufacturer and the user. It might be said that the distance between manufacturer and consumer has almost always prevented the habit of suggesting improvements from making itself felt. This difficulty could be avoided by having the apparatus manufactured nearer at hand.

The law proposed by the Council of the American Chemical Society, namely, that the duty-free law be entirely abolished, will undoubtedly prove satisfactory to a limited extent.[1] Apparently there is no great opposition to the law on the part of institutions that have been accustomed to duty-free importation and naturally no commercial firm that has made use of duty-paid materials before will oppose it.

As a matter of fact, many American firms make materials that are equal if not superior in many ways to the imported goods. Coors porcelain, made by the Herold Glass & Porcelain Company of Golden, Colorado, Pyrex Glass of the Corning Glass Company of Corn-

[1] See *Journal of the American Chemical Society*, January, 1919, Council Proceedings and *Journal of Industrial and Engineering Chemistry*, January, 1919.

ing, New York, the Nonsol Glass manufactured by Whitall, Tatum & Company at Milville, New Jersey, the especially fine physical control of the Kimble Glass Company at Vineland, New Jersey, and the production of fine special apparatus by Eimer & Amend of New York City—all show what can be done in this country in an emergency. If these conditions continue to be fostered we may in time lead the world in the production of scientific things. Certainly interest in this subject is growing and a movement is now on foot to interest manufacturers, jobbers and buyers in the possible publication of a journal devoted to chemical apparatus.

Undoubtedly the time will come, however, when some qualifying clause should be embodied in the tariff laws by which the defects of the proposed high protective tariff laws will be overcome, in order to assist especially qualified men to procure from abroad articles of great scientific merit though of little commercial value, which of necessity must be produced by the genius who devised the apparatus or prepared the compound. Probably this clause would necessarily be administered by some committee of scientists appointed by the government. Whether these defects to the proposed law are to be remedied by allowing certain things to come in duty-free as indicated, or by a system of bonuses to scientific institutions or members using material, is a debatable question.

To sum up the whole matter, it would seem to the authors that a method should be devised whereby all essential scientific material should be manufactured by the nation and while a general protective duty will probably be secured from Congress, it is our opinion that care should be taken that no obstacle be put in the way of the scientist doing constructive research.

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SCIENTIFIC EVENTS

THE USE OF REINFORCED CONCRETE IN SHIPBUILDING

REINFORCED concrete was first used in making a boat in France in 1849, but its use languished from 1849 until 1887 when a small concrete boat was built in Holland. This boat was first used by duck shooters on account of its high stability, and in 1918 it was still in use by a cement-products company in Amsterdam. Italy, Germany and England next fell in line, and a revival of concrete boat construction in France took place in 1916. Concrete boats were constructed also in New South Wales, Canada, China and Spain. After the outbreak of the war, as her ships were destroyed by submarines, Norway lost no time in building concrete ships. At the Fougner plant, at Moss, the Nannsiffiord, a 200-ton concrete cargo vessel was built and, after a successful trial trip, engaged in traffic between Norway and England and along the Norwegian coast. This was practically the pioneer seagoing self-propelled concrete ship.

In 1918 the construction of two fleets of concrete barges, each barge measuring 20 by 130 feet and of 550 tons capacity, was begun at New Orleans, La., and at Seattle, Wash. In 1918 the *Faith,* a concrete self-propelled merchant vessel of 5,000 tons dead-weight capacity, was launched at San Francisco, Cal.

In the stress to supply new ships reinforced concrete was adopted as a building material mainly for the following reasons: First, the concrete materials required are easily obtained, and the steel needed is employed in a form and quantity which make no strain on the rolling mills; second, the labor is less skilled and is recruited from a class totally different from the ordinary shipyard labor, so that the work does not increase the stress on the existing shipyards; third, a concrete ship costs no more than a steel ship and requires less expenditure for its upkeep; fourth, the time of construction is shorter.

When these facts are coupled with three considerations which make reinforced concrete most valuable for shipbuilding there seem to

be abundant reasons for its present larger use for that purpose. These considerations are: First, the concrete ship can be made practically waterproof; second, the reinforcement can be completely inclosed by the concrete so as to prevent rusting; third, concrete and reinforced concrete are absolutely fireproof.

Concrete used as construction material improves with age; there is no definite knowledge to-day as to the limits of its durability in time. It is not known to be attacked by insects; mould, vermin and bacteria find no soil for growth in it, and consequently ferroconcrete vessels can easily be kept clean. The ease of repairing a concrete ship by the simple application of new concrete is also a distinct advantage.

A chapter of "Mineral Resources of the United States" on cement in 1917, published by the United States Geological Survey, Department of the Interior, includes a section on concrete ships, by Robert W. Lesley, associate of the American Society of Civil Engineers, one of the pioneer manufacturers of Portland cement and a member of the committee on concrete ships of the American Concrete Institute. Mr. Lesley gives a full account of the ship *Faith*, the investigations of the American Concrete Institute, government construction, and patents for concrete ships, also a bibliography of concrete in shipbuilding.

In carrying out its emergency shipbuilding program the government made contracts for a large number of concrete ships. After the armistice the general program was changed; the total output of steel, wood and concrete ships was curtailed, but the infant concrete shipbuilding industry will probably continue to grow, for it still affords great opportunities for research and development.

EDUCATION AND SCIENCE IN THE BRITISH CIVIL SERVICE ESTIMATES

The estimates for civil services for the year ending March 31, 1920, as quoted in *Nature*, amounted in Class IV. (Education, Science and Art), to £41,251,610. The following are among the estimates:

United Kingdom and England

Service	Compared with 1918–19	1919–20 £
Board of Education	31,353,111	12,243,406
British Museum	209,714	83,572
Scientific investigation, etc.	113,974	59,733
Department of Scientific and Industrial Research	242,815	94,465
Universities and Colleges, United Kingdom, and Intermediate Education, Wales	945,700	624,000
Universities, etc., special grants	500,000	470,000
Scotland		
Public education	4,677,220	1,635,675
Ireland		
Public education	2,721,356	519,752
Intermediate education	90,000	—
Science and art	190,498	27,105
		Decrease
Universities and colleges ..	85,000	11,350

Details of some of these estimates of particular interest to men of science are as follows:

SCIENTIFIC INVESTIGATIONS, ETC.

Royal Society:	£
(i) Grant in aid of (*a*) scientific investigations undertaken with the sanction of a committee appointed for the purpose (£4,000) and (*b*) scientific publications (£1,000)	5,000
(ii) Grant in aid of salaries and other expenses of the Magnetic Observatory at Eskdalemuir	1,000
Meteorological Office	47,000
Royal Geographical Society	1,250
Marine Biological Association of the United Kingdom	1,000
Royal Society of Edinburgh	600
Scottish Meteorological Society	100
Royal Irish Academy	1,600
Royal Zoological Society of Ireland	500
British School at Athens	500
British School at Rome	500
Royal Scottish Geographical Society	200
National Library of Wales	8,900
National Museum of Wales:	
Grant in aid of the expenses of the museum	4,000
Special building grant in aid	20,000
Solar Physics Observatory	3,000
School of Oriental Studies	4,000

North Sea Fisheries Investigation	1,250
Imperial Mineral Resources Bureau	11,000
Edinburgh Observatory	1,974

SCIENTIFIC AND INDUSTRIAL RESEARCH	£
Salaries, wages and allowances	11,870
Traveling and incidental expenses	1,500
Grants for Investigation and Research:	
(1) Grants for investigations carried out by learned and scientific societies, etc.	13,570
(2) Grants for investigations directly controlled by the Department of Scientific and Industrial Research	55,000
(3) Grants to students and other persons engaged in research	25,000
Fuel Research Station	12,775
National Physical Laboratory	154,650

SCIENTIFIC NOTES AND NEWS

THE American Philosophical Society will procure a portrait of the late Edward C. Pickering to be hung in the hall of the society "as a token of the affectionate regard in which he was held by his fellow members." Professor Pickering was a vice-president of the society from 1909 to 1917.

DR. J. A. ALLEN, curator of mammals in the American Museum of Natural History, New York City, has been elected the first honorary member of the American Society of Mammalogists and the only person to be elected to such membership during the present year.

THE Harris lectures for 1920 at Northwestern University, are to be delivered by Professor Edward Sharpley Schafer, professor of physiology in the University of Edinburgh.

DR. E. H. SELLARDS, who has been state geologist of Florida since the organization of the survey in 1907, has resigned, and has accepted appointment as geologist in the Bureau of Economic Geology of the University of Texas. Herman Gunter who has been assistant geologist since the department was established has been appointed state geologist.

DR. HERMAN BIGGS, public health commissioner, New York state, presided over the Red Cross Conference held at Cannes this month.

CONSEQUENT upon the occupation of Alsace-Lorraine by the French, M. Esclangon, formerly assistant at the Bordeaux Observatory, has been appointed director of the Strasbourg Observatory.

W. M. SMART, M.A., Trinity College, Cambridge, has been appointed chief assistant at the Cambridge Observatory.

PROFESSOR VAUGHAN HARLEY has resigned the chair of pathological chemistry, which he has held for twenty-three years at the University of London.

CONCLUDING a study of the various phases of the food problem in Army aviation camps, Guy R. Stewart, assistant professor of agricultural chemistry, has resumed his duties at the University of California. Dr. Roy E. Clausen, assistant professor of genetics, has also returned to the university after nearly two years' service in the army.

THE following members of Stanford University have been released from government service and resumed their academic duties with the opening of the spring quarter, March 31, 1919: Bailey Willis, professor of geology; William Frederick Durand, professor of mechanical engineering; Ernest Gale Martin, professor of physiology; Clelia Duel Mosher, assistant professor of personal hygiene and medical adviser of women; Albion Walter Hewlett, professor of medicine and Stanley Stillman, professor of surgery.

A COMPLIMENTARY dinner was tendered Colonel Alexander Lambert, M. C., U. S. Army, president-elect of the American Medical Association, by his professional friends in New York City, on April 12. About 400 of the leading physicians of New York and the east attended. Dr. George D. Stewart acted as toastmaster. The speakers were Colonel Frank Billings, M. C., U. S. Army, Chicago; Dr. William S. Thayer, of Baltimore; Dr. George E. Brewer, of New York, and Rev. Charles A. Eaton, of New York. Dr. Lambert responded with an account of his experiences abroad as chief medical director of the American Red Cross hospitals.

The *Journal of the American Mathematical Society* states that Professor Joseph Allen, of the College of the City of New York, and Professor W. H. Metzler, of the University of Syracuse, have gone to France on army educational work. Captain P. L. Thorne, assistant professor of mathematics at New York University, has recently returned to his university work. He served at the front in France with the Sixtieth Heavy Artillery regiment. Captain A. L. Underhill, of the University of Minnesota, has been appointed Commandant at the University of Grenoble in France, where several hundred American soldiers are taking courses while awaiting their opportunity to return home.

Professor Miyajima, of Tokyo, has arrived in Brazil where he is to do pathological research work at the Butantan Institute.

Messrs. Hoyt S. Gale and J. B. Umpleby, of the U. S. Geological Survey, have gone to France to investigate certain questions of mineral resources, particularly potash salts, involved in the peace negotiations.

UNIVERSITY AND EDUCATIONAL NEWS

The New Haven Section of the American Chemical Society will give a scholarship in chemistry in the Yale Graduate School for the year 1919–20, with the understanding that the scholarship be given to "a graduate student who is a candidate for a higher degree in the department of chemistry. The recipient must be a resident of the territory covered by the New Haven Section, and be selected by a committee composed of the president and councillor of the section and the chairman of the department of chemistry of Yale University."

The Iowa state legislature has appropriated $175,000 for the establishment of a psychopathic hospital at the state university. This hospital will be open to both public and private patients suffering from mental disorders. The same legislature also extended the so-called Perkins law to include adults. By the Perkins law an orthopedic hospital is maintained at the university for the free treatment of the crippled children in the state.

Assistant Professor Leo F. Rettger has been promoted to a professorship of bacteriology at Yale University. Dr. Rettger received his B.A. and M.A. at the University of Indiana, and his Ph.D. from Yale in 1902. After studying abroad he was for five years research scholar and fellow at the Rockefeller Institute for Medical Research.

In the department of chemistry of the Massachusetts Institute of Technology the following appointments have been made: William H. McAdams, to be assistant professor of chemical engineering; Dr. Charles S. Venable and Dr. William G. Horsch, to be research associates in applied chemistry, and Thomas M. Knowland, to be research assistant in the same department.

At the University of Strasbourg, professor René M. Fréchet, of the university of Poitiers, has been appointed professor of mathematics, and Pierre Weiss, professor at the Polytechnikum, Zurich, professor of general physics.

Professor E. Wiechert, of Göttingen, has been appointed professor of geodesy and geophysics at the University of Berlin.

The Cavendish professorship of experimental physics, at the University of Cambridge, recently vacated by Sir J. J. Thomson, has been filled by the appointment of Sir Ernest Rutherford, of the University of Manchester. Sir J. J. Thomson retains an honorary professorship.

DISCUSSION AND CORRESPONDENCE

ERRONEOUS GENERIC DETERMINATIONS OF BEES

In Science, 49: 71, Professor Stevens makes some statements regarding a paper with the above title in Science, 48: 368. He thinks many important factors influencing generic limitations were overlooked. For example, he points out that the average varies in proportion to the size of the region. In comparing the New Jersey with the local list I thought that fact was obvious. It was intended to discuss neither various factors nor

particular cases, but only to mention an impersonal criterion for showing that the generic determinations of bees in the lists cited were erroneous.

At first he takes the second of my alternatives and holds that the bees differ from all of the other groups of insects, and even among plants are only comparable with the Poales. Then he changes about, makes the erroneous assumption that the bees and Lower Aculeata were more completely represented in the local list, and arrives at the mistaken conclusion that such a condition would explain the discrepancy between the averages of these insects and the others.

Stevens compares *Andrena* with *Carex*. The so-called genus *Andrena* reminds one of the time when all of the owls were referred to *Strix*. It would not seem so large if the sexes were not described as distinct species. In a recent paper only 4.6 per cent. of the so-called species were described from both sexes. If one is so careless of his entomology and diction as to say species when he means sex, what is to keep him from saying subgenus or quidnunc-group instead of genus? One who ignores the fact that bees have two sexes is not competent to distinguish any genera except those based on characters common to both sexes. If you should disregard the secondary sexual characters and the habits of the females, how well could you understand the classification of the Hymenoptera in general.

Small divides *Carex* into two subgenera and 34 what-d'ye-call-'ems—named groups with subfamily, family, ordinal and other endings. One might like to know what categories the organisms form, not how they are to be forced to fit preconceived categories. The genus seems to be regarded with superstitious reverence when it contains 34 groups of the second order. Even the analogy of the Poales is against the bees. In the Fargo flora the Poales stand 2.3 against a general average of 1.8, while in the Carlinville list the bees stand 6. 5 against an average of 1.7.

Compared with the general average the bees and Lower Aculeata show a great discrepancy in both lists without regard to their percentages in the composition of them. The Coleoptera, respectively 33.7 and 10.6 per cent., approach the average in each list. In the local list the Coleoptera are quite fragmentary compared with the Diptera, but the average is about the same. The list of Rhopalocera, which is as complete as that of the bees, shows an average of 1.4 to the bees 6.5, while the Heterocera, which are quite fragmentary, average 1.2. The Bombyliidæ, Conopidæ, Syrphidæ, Tachinidæ and Muscidæ, in which the local list is quite complete, show 1.7 while the other Diptera average 1.6. The 437 local entomophilous flowers on which insect visitors were taken average 1.6 while the 520 plants of the Fargo flora average 1.8.

Although Stevens argues against small groups he says that he believes in the recognition of them, but he doubts the necessity of forcing them upon every one. The statement that neglected groups will be subdivided about like those which have been more thoroughly studied hardly involves an attempt to force small groups upon any one. You may say that a river runs south without trying to force the water on those who live down stream.

CHARLES ROBERTSON
CARLINVILLE, ILLINOIS

GEOMORPHOLOGY

TO THE EDITOR OF SCIENCE: The letter from Professor John L. Rich in your issue of January 11, 1918, escaped my notice at the time and my attention was not drawn to it until very recently. Hence this belated reply.

I agree thoroughly with Professor Rich that geomorphology has an interpretative geological value, and I admit that, for the sake of economy of space, it may be necessary sometimes to compress the geographical aspect of a geomorphological description and its geological interpretation into a single paper from which the geographer and the geologist will each attempt to pick out the points that interest him. The introduction of certain geological dates into a paper with such a double purpose is excusable, but it is the thin end of a wedge which may lead to much obscurity.

The artifice of placing geological names in

footnotes, where they do not break the continuity of the descriptive text, and of adding further geological information in an appendix is useful in drawing attention to the geological value of an interpretation of the physiography in a paper written primarily to explain and describe the land forms. This method I adopted in "The Physiography of the Middle Clarence Valley, New Zealand."[1]

In the case of my paper "Block Mountains in New Zealand," to which Professor Rich refers, the age of the covering strata in Central Otago is uncertain within fairly wide limits. The statement that they are probably Oamaruian but possibly Wanganuian would not convey much definite information to American readers. When I was preparing the paper for publication the temptation to discuss the age question was strong, and I yielded to it. Realizing that the discussion would be out of place in the body of the paper I placed it in an appendix, which, however, the editor wisely omitted.

This article was not written with a dual purpose. The geological significance of the land forms of Central Otago, as well as the closely related forms throughout New Zealand had already received full attention in a paper entitled "The Structure and Later Geological History of New Zealand," published in the *Geological Magazine*.[2] This and "Block Mountains in New Zealand" were in preparation at the same time, the one frankly geological, the other geographical. As such the latter was intended for publication in a geographical periodical and was offered to the Royal Geographical Society, which was unable, however, to find space for it in its *Journal*.

C. A. Cotton

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"A WAVE OF LIFE"

An interrelation of organisms somewhat suggestive of Hudson's "wave of life" was observable about the University of Montana Biological Station on Flathead Lake the past season.

During the summer of 1917 flowers bloomed luxuriantly about the station grounds, and humming-birds and butterflies visited the flowers very commonly. Rodents were present in normal numbers, but attracted no particular attention.

Conditions were markedly changed during the summer of 1918. For unknown reasons the rodents became very abundant. Pine squirrels and chipmunks were everywhere present. Spermophiles appeared on the station grounds for the first time in the history of the institution. The chipmunks quickly cleared the ground of flowers and ascended to the tops of trees to strip the honeysuckle vines of their blossoms. Deprived of their natural food in this vicinity humming-birds were rarely seen and butterflies were very uncommon. Pine squirrels kept the ground under the pine trees well strewn with pine cones, but the effect of this inroad upon the pine cones was not so apparent upon other forms of life.

Weasels, which were not observed about the station the preceding summer, were seen several times during 1918. Great horned owls hooted at night in the nearby tree tops. These birds had not been reported for 1917.

G. B. Claycomb

University of Illinois

QUOTATIONS

THE PHYSIOLOGY OF A WORKING DAY

Gradual reduction of the hours of labor from ten or nine to eight, and now to seven or six, must have made many people wonder whether some scientific basis might not be found for the hours which should be worked in various trades. Major A. C. Farquharson raised the matter in the discussion on the second reading of the Ministry of Health Bill. Speaking as one who had spent the greater part of his professional life in the service of the miner, he expressed his astonishment that members of the House of Commons should be so ready to put forward the idea that the number of hours a man should work day by day was to be settled by the arbitrary

[1] Geog. Jour., vol. 42, 1913, pp. 225–46.

[2] December 6, vol. 3, 1916, pp. 243–249, 314–320.

capricious decision of the mass. He contended that it was a scientific problem, and suggested that if science could establish that a normal man could work up to a given standard without detriment to his physical condition and without injury to his health or chance of longevity, the number of hours of a working day could be standardized. In the discussion on the bill in committee he contended that there ought to be a scientific department, working in relation with the Ministry of Health, to decide various matters of a physiological nature in relation to capital and labor, including suitable hours of work. We may point out that a large amount of scientific work had been done in this direction, some of which is summarized in the reports of the Health of Munition Workers Committee, but the subject is complex and physiology is far from having found a complete solution. It is comparatively easy to estimate the amount of energy given out in various kinds of work at various paces, but muscle fatigue is only one and probably the least important element in fatigue. There is in addition the mental element, which can not be measured, and the nervous element, which it will be possible to measure with difficulty if at all. Nervous fatigue occurs in the initiating and distributing nervous mechanisms of the brain and spinal cord, which are more quickly fatigued than the contracting muscles; consequently in the animal body the impulses to activity, springing from the brain, can not bring the muscles far towards complete fatigue before their sources are themselves fatigued and impotent. Though a tired man may refer his tiredness to the muscles, in reality the most severe bodily activity does not produce any close approach to complete fatigue of the muscles. The fatigue is of the nervous system, though its effects may be referred to the muscles. The conclusion of the committee was that the problems of industrial fatigue were primarily, and probably almost wholly, problems of fatigue in the nervous system and of its direct and indirect effects. Another complicating matter is that the human body seems to be adapted to withstand short spells of severe labor, broken by longer spells of rest; the point is illustrated by the story of a wager between two officers at the front as to the time to be taken in making equal lengths of a trench, each with an equal squad of men. One officer let his men work as they pleased, but as hard as possible. The other divided his men into three sets, to work in rotation, each set digging their hardest for five minutes and then resting for ten. The second team won easily. Another conclusion—this time in a report by Dr. H. M. Vernon to the same committee—was that the hours of labor ought to be varied between wide limits according to the character of the work performed. This seems the most promising line of inquiry.—*British Medical Journal.*

SCIENTIFIC BOOKS

Injurious Insects and Useful Birds. By F. L. WASHBURN, M.A. Philadelphia, J. B. Lippincott Co. Pp. xviii + 453. Price $1.75.

This little book is one of a series called "Lippincott's Farm Manuals" edited by Dr. K. C. Davis, and now containing about a dozen hand-books on as many phases of agricultural practise. The author of this volume, Professor Washburn, has for many years held the positions of state entomologist of Minnesota, professor of entomology, University of Minnesota and entomologist of the Agricultural Experiment Station, consequently as an investigator and teacher he is in possession of some first-hand knowledge and is posted regarding the work of others. A list of questions at the end of each chapter shows the custom of the teacher.

The book is divided into twenty-one chapters, with headings as follows: Loss to Agriculture Due to Insects and Rodents; Farm Practises to Lessen Insect and Rodent Injuries; External Structure of Insects, Orders, Metamorphosis; Collecting and Preserving Insects; Insectides and Spraying; Fumigation; Insects Injurious to the Apple; Insects Affecting the Pear and Quince; Plum, Peach and Cherry Insects; Insect Pests of Berries and Grapes; Principal Insects affecting Citrus

Fruits; Insects affecting Field Crops and Pasturage; Insects affecting Truck Crops and the Vegetable Garden; Insect Enemies of Greenhouse and House Plants and of the Flower Garden; Insects affecting Shade Trees; Insects affecting Man and the Household; Insects and Insect-like Animals attacking Stock and Poultry; Mill and Elevator Insects and Mill Fumigation; Our Insect Friends; The Relations of Birds to Agriculture; Some four-footed pests of the Farm.

There are four colored plates, and 414 illustrations in the text, many of the figures are from original photographs and drawings. and the others are borrowed from various sources, due credit being given.

This little volume differs from most other manuals of injurious insects in that considerable information regarding common birds and rodents may be found in the same book. Of course where so many species are treated within the limits of a small-sized volume, the account of each must necessarily be very brief. Probably the value of the work would have been enhanced by giving after each one or two references where the reader could obtain more complete information.

Nevertheless the author has condensed a large amount of information in this small volume which is well printed and supplied with index. It will prove a convenient manual for all growers of plants and keepers of live stock.

W. E. Britton
Agricultural Experiment Station,
New Haven, Conn.

ANTHROPOLOGICAL RESEARCH[1]

At the meeting of the American Anthropological Association held in Baltimore, December 27, Professor J. C. Merriam, representing the National Research Council, made a formal statement of the plans of the council in regard to the organization of science, and requested an expression of opinion on the part of the American Anthropological Association in regard to the position of anthropology in the work of the National Research Council.

In consequence of this request and the discussion following it, the undersigned committee was appointed for the purpose of giving to the National Research Council information in regard to the work actually done by American anthropologists. A statement has been added pointing out the causes for the slow development of certain branches of anthropology.

The committee has submitted a number of questions to American anthropologists and attached to this are a number of replies to our circular letter.

The general tendency of the scientific work of American anthropologists may briefly be summarized as follows: It is but natural that in a country like our own, which contains the remains of a considerable number of primitive people, the historical interest in the aborigines, combined with the ease of accessibility of the remainder of the ancient tribes, should bring it about that inquiries relating to their customs, languages and physical types should dominate American anthropological research, and that theoretical work should be based very largely upon the results obtained from a study of American tribes. The methods which give the easiest results in regard to these problems are archeological, ethnographical and linguistic, and for this reason these three lines of inquiry have hitherto predominated in the research work of American anthropologists.

At the same time the necessity for a broader outlook is keenly felt. The Field Museum of Natural History has included in the scope of its work Eastern Asia, Malaysia and Melanesia. Harvard University has expanded its work over Africa. The University of Pennsylvania has undertaken research work in South America, the American Museum of Natural History and the United States National Museum, in Asia, and a few other attempts of similar kind for obtaining a wider basis for research in cultural history may be noted.

[1] Report of the Committee of the American Anthropological Association to Professor G. E. Hale, chairman of the National Research Council, Washington, D. C.

The field of work of American anthropologists is also in part determined by the character of the institutions that maintain anthropological work. The Bureau of American Ethnology which forms part of the Smithsonian Institution is by law restricted to work on the natives of America and the Hawaiian Islands. Most positions held by working anthropologists are museum positions, and consequently the scientific work is largely restricted to those aspects of anthropology that yield tangible specimens. University positions are on the whole of such a character that the funds necessary for the conduct of field work are not supplied by the universities, but if available at all, come from museums.

Anthropologists have felt for a long time that their work needs expansion, and many attempts have been made to free anthropological research from the restrictions dependent upon the association of anthropological work with museums on the one hand, and from those conditions that tend to give undue preponderance to work on American Indians on the other hand. Attempts have been made particularly to direct attention to African problems, which are of importance to us on account of our large negro population, and also to investigations on racial anthropology among the white and negro populations of the United States. Work of this kind needs financial support, but all attempts have failed to interest the government institutions which command considerable funds, or private individuals, to support work of this type. There is a peculiar hesitancy in regard to undertakings of this kind, which will not be overcome until more work on a smaller scale has been done. Investigations of this description have been undertaken by American anthropologists and by educators, sociologists and medical men with anthropological leanings.

Recently, biologists have also directed their attention to this subject, but methods applied and results obtained up to this time are quite unsatisfactory. Work on human paleontology is also not vigorously pursued.

The difficulty of giving anthropological research an adequate position in the scheme of the National Research Council is largely based on the fact that the humanities find no place in the general scheme of work of the Research Council. While anthropology must necessarily be based on the one hand on biological science, on the other hand it is intimately associated with the humanities. It is impossible to treat even the biological problems of anthropology without a due regard to the cultural aspect of anthropology, because the forces which determine the development of human types are to a very large extent cultural forces.

The peculiar position of anthropology brings about close contact with a great many different sciences—biology, geology, paleontology, geography, psychology, history, linguistics and the whole range of humanities. Cooperation will be necessary according to the particular type of problems taken up, and anthropology will be best served by an entirely free association with different subjects, according to the need of each case.

It is the opinion of the undersigned committee that the appointment of a director of anthropological work, who would have a dominating influence over organized work, would not be helpful on account of the great diversity of subject matter included in anthropology, and might prove decidedly prejudicial on account of the necessity of developing this subject in different directions. Much better results would undoubtedly be obtained by regular meetings of representative scientists, and by the appointment of a secretary who would carry out the necessary clerical work.

FRANZ BOAS, *Chairman*,
ALEŠ HRDLIČKA,
ALFRED M. TOZZER

NEW YORK CITY,
March 6, 1919

SPECIAL ARTICLES

EGG-WEIGHT AS A CRITERION OF NUMERICAL PRODUCTION IN THE DOMESTIC FOWL[1]

IN connection with a study of the manner of inheritance of egg-weight in the domestic

[1] Contribution 251 from the Agricultural Experiment Station of the Rhode Island State College, Kingston, R. I.

fowl, conducted for several years at the Rhode Island Agricultural Experiment Station, there has been evolved a new method for the detection of those birds in a flock that are characterized by higher producing ability. The method is not based upon data involving observed numerical production in any way, but upon the tendency on the part of normal hens to manifest, at certain periods of the year, a gradual increase or a gradual decline in the size and weight of the eggs which they lay.

It has been found that when the numerical production curve of a flock of hens of the same approximate age and condition, and characterized by mediocre producing ability, is plotted on monthly ordinates (aside from the mode of December production of the pullet year which is sometimes manifested if the hens were hatched very early in the season or are high producers) two modes appear, one in April and one in September. These modes, or maxima, represent the peaks of production for the first laying year.

It has also been found that when the curve of mean egg-weight is plotted on similar monthly ordinates, two modal points appear, one in April and the other in September. These weight modes, or weight maxima, are approximately coincident with the production maxima.

When, however, one analyzes the performance of individual birds at the period of these maxima, one finds that, while the majority show an egg-weight which has markedly increased over the mean weight of the first ten eggs laid at the beginning of the laying year, some have not shown such an increase, and some have shown an actual decrease. When the increase or decrease in mean egg-weight is measured as a percentage-increase or as a percentage-decrease, some birds may show an increase of 10 per cent. or more while others show a decrease of equal amount.

The question naturally arose whether the hens which showed the greater increase in mean egg-weight for April or for September also manifested the higher productions for the first laying year. Such correlations were computed and it was learned that in the majority of cases the hens which gave the higher-percentage increase in egg-weight during these months also showed the higher productions for the year. The flock could easily be separated into production-groups based upon the percentage of increase (or decrease) in mean egg weight. As a rule the correlation was more perfect in September than in April.

Correlations between the percentage of increase in mean egg-weight and numerical production were also attempted when the former were based upon the mean weight of *only ten eggs* laid as nearly as possible to the absolute weight-mode for April and for September respectively. It was learned from these computations that the correlation was even more perfect when the smaller number of eggs was employed in the computations. The following table gives the results for the autumnal weight maximum, based on the "10-egg test."

TABLE I

Showing the Mean Annual Production, for the First Laying Year, of Groups of Hens Selected for Varying Percentages of Increase or Decrease in Mean Egg-weight of Ten Eggs or Less Laid at the Period of the Autumnal Weight Maximum

Percentage-Class: Birds Selected for Increase in Egg-Weight Indicated Below. Per Cent.	Number of Individuals Making the Record	Mean Production for the First Laying Year
> 13	3	147
> 11	6	145
> 10	7	143
> 9	8	144
> 8	10	144
> 7	12	139
> 6	12	139
> 5	14	135
> 4	16	134
> 3	19	131
> 2	21	125
> 1	23	125
> 0	26	124
< 0	5	108
< 6	19	112
Total flock	31	120

From the data presented in the table it appears that higher production is correlated very definitely with higher percentages of increase in egg-weight. The maximum group-production (147) occurred in those hens whose mean increase in egg-weight was above 13 per cent. in the "10-egg test." Selecting above 10 per cent. gave seven birds whose mean production was 143 eggs. Selecting above 6 per cent. gave 12 hens whose mean production was 139 eggs. On the other hand selecting the hens which gave a decrease in egg-weight ("< 0 per cent.," in the table), gave five hens with a mean production of only 108.

The superiority of the "10-egg test" in establishing the correlation with numerical production in this instance clearly brings the testing of egg-production of hens into the same class with testing milk-production of dairy cows, in which case Gavin and also Wilson have pointed out that under suitable conditions the one day test may be of greater value than the seven-day, the 30-day or the year test.

With these points openly in mind, and only with the purpose of stimulating further investigation and discussion, the author presents the following brief summary of his results with a single flock as expressing a biological fact which, if later proved to be of general application, may take its place as a fundamental law of production in the domestic fowl:

The innate egg-producing ability of a hen is manifested, not only by the number of eggs laid within a year, or within some longer or shorter period of time, but also by the degree of increase or of decrease in the mean weight of her eggs, when this increase or decrease (calculated as a percentage-increase or percentage-decrease) is measured at those periods of laying (the vernal and autumnal maxima) characterized by the markedly increased laying of the flock; and on this basis, groups of hens characterized by higher producing ability can be differentiated as accurately as, and more easily than by other known means.

The validity of this proposed law of production is supported by detailed evidence in an article to appear in *The American Naturalist.*

PHILIP HADLEY
R. I. AGRICULTURAL EXPERIMENT STATION

SOCIETIES AND ACADEMIES

THE NATIONAL ACADEMY OF SCIENCES

THE program of scientific sessions of the meeting held in Washington on April 28, 29 and 30, was as follows:

MONDAY, APRIL 28

Morning Session

ALFRED G. MAYOR: The age of the fringing reef of Tutuila, American Samoa.

CHARLES D. WALCOTT: Seaweeds and sponges of the Middle Cambrian.

ROBERT G. AITKEN: The spectra of the visual binary stars.

GEORGE E. HALE, F. ELLERMAN, S. B. NICHOLSON and A. H. JOY: The magnetic polarity of sun spots.

WALTER S. ADAMS and A. H. JOY: The motions in space of some stars of high radial velocity.

WALTER S. ADAMS and G. STRÖMBERG: The use of spectroscopic method for determining the parallaxes of the brighter stars.

ADRIAAN VAN MAANEN (introduced by George E. Hale): Evidence of stream-motion afforded by the faint stars in the Orion nebula.

GRAHAM LUSK and H. V. ATKINSON: The production of fat from protein after giving meat in large quantity to a dog.

WILLIAM S. HALSTED: End-to-end anastomosis of the intestine—experimental study.

ROBERT M. YERKES (introduced by George E. Hale): Psychological examining in the United States Army.

Afternoon Session

FREDERICK H. SEARES (introduced by George E. Hale): Relation between color and luminosity for stars of the same spectral type.

FREDERICK H. SEARES, A. VAN MAANEN and F. ELLERMAN (introduced by George E. Hale): Deviations of the sun's general magnetic field from that of a uniformly magnetized sphere.

W. W. CAMPBELL: The solar corona.

HERBERT E. GREGORY (introduced by W. M. Davis): Plans for exploration of the Pacific.

FRANCIS G. BENEDICT, W. R. MILES and ALICE JOHNSON: The temperature of the human skin.

*S. J. Meltzer and M. Wollstein: The influence of degeneration of a vagus nerve upon the development of pneumonia.

Demonstration of war research problems at the National Bureau of Standards.

Evening Session

William Ellery Hale Lecture, by James Henry Breasted, professor of Egyptology and Oriental history, University of Chicago. Subject: *The origin of civilization—from the old stone age to the dawn of civilization.*

Reception to members and guests at the United States National Museum, National Gallery of Art.

TUESDAY, APRIL 29

Morning Session

Edwin H. Hall: The effect of great pressure on the electric conductivity and thermo-electric properties of metals.

Edwin H. Hall: Comments on the results of Bridgman's experiments.

Charles Lane Poor (introduced by J. S. Ames): Line of position computer.

Irving Langmuir: The arrangement of electrons in atoms and molecules.

Henry F. Osborn: Paleomastodon, the ancestor of the long-jawed mastodons only.

Henry F. Osborn: Seventeenth skeletons of *Moropus:* probable habits of this animal.

Thomas B. Osborne and Alfred J. Wakeman: The preparation of vitamine-free proteins.

Arthur G. Webster: Tentative results in interior ballistics.

Arthur G. Webster: Tentative results in elastic hysteresis.

Afternoon Session

Edwin H. Hall: Thermal conduction in metals, from the standpoint of dual electric conduction.

Edwin H. Hall: The thermo-electric equation $P = T\ dV/dT$ once more.

A. O. Leuschner and Sophia H. Levy: Perturbations of minor planets discovered by James C. Watson: (104) Clymene (106), Dione (168), Sibylla (175), Andromache. Read by title.

Arthur G. Webster: The most perfect tuning fork.

Arthur G. Webster: Angle of repose of wet sand.

Edward Kasner: Geometry of the wave equation.

C. G. Abbot: Rotating projectiles from smooth-bore guns (illustrated).

C. G. Abbot: Means for measuring the speed of projectiles in flight (illustrated).

C. G. Abbot: Recent simultaneous measurements of the solar constant of radiation at Mount Wilson, California, and Calama, Chile (illustrated).

John C. Merriam: Human remains from the Pleistocene of Rancho La Brea (illustrated).

William Ellery Hale Lecture, by James Henry Breasted, professor of Egyptology and Oriental history, University of Chicago. Subject: *The origin of civilization—the earliest civilization and its transition to Europe.*

WEDNESDAY, APRIL 30

Afternoon Session

Joint session National Academy of Sciences with National Research Council.

George E. Hale: The past work and future plans of the National Research Council.

John C. Merriam: The Division of General Relations, Section on Relations with Educational Institutions and State Committees.

R. A. Millikan: The Division of Physics, Mathematics, Astronomy and Geophysics.

Dayton C. Miller: Pressures and velocities, internal and external, due to the discharge of large guns.

E. W. Washburn: The Division of Chemistry and Chemical Technology.

A. A. Noyes: Nitrate investigations.

Whitman Cross: The Division of Geology and Geography.

R. G. Hussey: The Division of Medicine and Related Sciences.

R. M. Yerkes: Psychology in relation to the war.

C. E. McClung: The Division of Agriculture, Botany, Forestry, Zoology and Fisheries.

G. H. Clevenger: The Division of Engineering.

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